Data preparation instructions for the Fire Regime Condition Class Mapping Tool (FRCCmt).

The following instructions show how to download the Hydrologic Unit Code (HUC) layer from the Geospatial Data Gateway (datagateway.nrcs.usda.gov), convert it to a raster, then clip the Biophysical Setting (BpS) and Succession Class (SClass) rasters to the HUC raster. The same process that is used to clip the BpS and SClass rasters can also be used to clip additional rasters to the HUC raster if desired. Lastly, if the BpS raster is LANDFIRE Refresh versions 1.0.5 or 1.1.0, it will be converted into a BpS Group raster. For the purposes of this guide, the instructions are for ArcGIS 10, but it is fairly easy to use them for ArcGIS 9.3 also.

1. **Download the Hydrologic Unit Code (HUC) raster from the Geospatial Data Gateway.** The Hydrologic Unit Code shapefiles are available from the Geospatial Data Gateway. There are shapefiles available for eighth, tenth and twelfth code HUC layers. It is possible to download all 3 layers, but this guide will only download the HUC_12 layer because it is only necessary to download that layer if you are following the methodology in this guide. Later it will be converted it to a single raster with HUC_8, HUC_10 and HUC_12 codes in the attribute table. Download the HUC shapefile with the following steps:

   a. Launch browser and go to datagateway.nrcs.usda.gov
   b. Select **Order by Bounding Rectangle**.
   c. Enter the lats and lons for the bounding rectangle that encompasses the study area you want to download HUCS for. Lats and lons can be entered as either decimal degrees or degrees, minutes and seconds. If you don't know the coordinates for the bounding rectangle, Google Earth can easily be used to identify the lats and lons that encompass the area of interest.
   d. Click on **Check Desired Coordinates.** A red bounding rectangle will appear on the display showing the area of interest that HUCs will be downloaded for. If the rectangle does not appropriately show the area of interest, refine the coordinates until it encompasses the correct area.
   e. Click **Submit Desired Coordinates**.
   f. A list of data layers available for download appears. Scroll down to the *Hydrologic Units* section and select the *12 Digit Watershed Boundary Dataset*.
   g. Click **Continue.**
   h. Under *Format* select ESRI Shape, indicating that the download will come as an ESRI shape file.
   i. Under *Projection*, select the desired projection.
   j. Under *Inclusion* click the **Here** button to change the Data Inclusion option to Extract. This will specify that the downloaded shapefile will only contain HUC12 polygons that lie within the specified coordinates.
   k. Click **Continue**.
   l. Provide your contact information and click **Continue**.
   m. Review the order information and click **Place Order**.

n. The Geospatial Data Gateway will send you an email when your data is ready for download. Open the email when it arrives and click on the link for your HUC layer to download the zip file to your computer. After the zip file is downloaded, unzip it. The shapefile containing the HUC 12 polygons will be named wdbhu12_a_extract.

2. **Prepare the HUC raster for use with the FRCCmt.** The HUC shapefile downloaded previously will have extraneous HUC polygons removed, be reprojected (if necessary) and converted to a raster.
   a. Load the BpS and SClass rasters that have been downloaded from the National Map. A convenient way to download rasters from the National Map is via the LANDFIRE Data Access Tool (LFDAT). For guidance on how to use LFDAT, consult the LFDAT User Guide available at www.niftt.gov.
   b. Load the HUC12 shapefile into ArcMap. If the above instructions were used to download the file, it will be named wbdhu12_a_extract.
   c. Remove Huc12 polygon features that are outside the study area.
      i. Select the Huc12 layer from the ArcMap TOC
      ii. From the ArcMap *Editor* toolbar, select **Editor > Start Editing**.
      iii. Select the Huc12 layer and click on **OK.**
      iv. Select the Huc12 features that are outside the study area and delete them.
      v. Save the Huc12 layer and stop editing by selecting from the ArcMap *Editor* toolbar **Editor > Stop Editing**.
   d. Re-project the HUC12 shapefile (wbdhu12_a_extract) to the BpS raster's spatial reference (if it is not in the desired spatial reference).
      i. From ArcToolbox, select **Data Management Tools > Projections and Transformations > Feature > Project**.
      ii. In the *Project* dialog, set *Input Dataset* to the Huc12 shapefile (wbdhu12_a_extract).
      iii. Set *Output Dataset* to the path and shapefile name for the output projected shapefile. (For example, C:\sample\huc12p)
      iv. Click the button to the right of *Output Coordinate System*.
      v. Set the spatial reference in the *Spatial Reference Properties* dialog.
         1. Click on **Import.**
         2. Select the BpS raster and click **Add.**
         3. Click **OK** to exit the *Spatial Reference Properties* dialog.
      vi. Click **OK** on the *Project* dialog.
      vii. Make sure the projected Huc12 shapefile is loaded into ArcMap. *ArcMap 10 appears to have a bug that the output shapefile is not loaded after it's created.*
   e. Convert the projected HUC12 shapefile to a raster.
      i. From ArcToolbox, select **Conversion Tools > To Raster > Polygon to Raster**.
      ii. In the *Polygon to Raster* dialog, set *Input Features* to the projected Huc12 shapefile (huc12p).
      iii. Set *Value Field* to "HUC_12".
      iv. Set *Output Raster Dataset* to the path for the output Huc 12 raster. (For example, C:\sample\huc12r)
      v. Set *Cellsize* by clicking on the browse button to the right and navigating to the BpS raster that you will be using with the FRCC Mapping Tool (FRCCmt).
      vi. Click on **Environments**.

  vii. In the *Environment Settings* dialog, set *Processing Extent > Extent* to **Intersection of Inputs**.

  viii. Set *Processing Extent > Snap Raster* to the BpS raster.

  ix. Click **OK.**

  x. Click **OK** on the *Polygon to Raster* dialog.

 f. Add HUC_10 and HUC_8 attributes to the Huc12 raster's attribute table.

  i. Open the attribute table for the HUC12 raster (huc12r).

  ii. Export the attribute table to a CSV file

   1. Click the *Table Options* button and select **Export**.

   2. From the *Export Data* dialog that comes up, click the **Browse** button to the right of *Output table*.

   3. In the *Saving Data* dialog:

    a. Navigate to the folder where you want to put the exported attribute table.

    b. Set *Save as type* to **Text File.**

    c. Set *Name* to "Huc12.csv"

    d. Select **Save.**

   4. Select **OK.**

   5. A dialog will ask *Do you want to add the new table to the current map?* Select **No.**

  iii. Import the CSV into Access and add HUC_10 and HUC_8 columns. (The instructions below are for Access 2007.)

   1. Open Huc12.csv in Access using the *Text Import Wizard.*

    a. Open Access with a blank database in mdb format called Huc.mdb.

    b. Import the Huc12.csv file into the Huc.mdb.

     i. From Access ribbon bar, go to **External Data > Import > Text File**.

     ii. From the *Get External Data* dialog, click **Browse** and navigate to the Huc12.csv file. Click **OK**.

     iii. From the *Import Text Wizard*, click **Next**.

     iv. Select *First Row contains Field Names* and set the *Text Qualifier* to double-quote. Click **Next**.

     v. Click **Next**.

     vi. Select *Choose my own primary key* and set it to **HUC_12**. Click **Next.**

     vii. Set *Import to Table* to "Huc12". Click **Finish.**

     viii. Click **Close**.

    c. Add HUC_10 and HUC_8 columns to HUC12 table.

     i. Right-click on Huc12 table in Access table list, select **Design View.**

    ii. Add a column named "HUC_10". Set the *Data Type* to **Text** and the Field Size to "10".

    iii. Add a column named "HUC_8". Set the *Data Type* to **Text** and the Field Size to "8".

    iv. Close the Design View for the Huc12 table. When Access asks if you want to save the changes to the table, answer **Yes**.

  d. Populate the HUC_10 and HUC_8 columns.

    i. From the Access ribbon bar, select **Create > Other > Query Design.**

    ii. In the *Show Table* dialog, Select **Huc12** and click **Add**.

    iii. Close the *Show Table* dialog.

    iv. Right click in the top half of the query's Design View and select **SQL View**.

    v. In the SQL View, enter the following query:

> UPDATE Huc12
> SET Huc12.HUC_10 = Left(Huc12.HUC_12, 10),
>   Huc12.HUC_8 = Left(Huc12.HUC_12, 8)

It is OK to simply copy and paste this query into Access. The above query will update the Huc12 table setting the HUC_10 column in each row to the left most 10 characters and the HUC_8 column to the left most 8 characters in the HUC_12 column. Make sure that the HUC_12 column is actually called HUC_12, or use the corresponding column name in your table.

    vi. From the Access Ribbon Bar, click on **Design > Results > Run** to run the query.

    vii. Access will tell you that you are about to update some rows. Select **Yes**.

    viii. Open the *Huc12* table by double clicking on it in the *All Tables* list. Verify that the *HUC_10* and *HUC_8* columns have been populated correctly.

    ix. Close Access. Access will ask if you want to save changes to Query 1. Select **No**.

iv. Join the HUC12 table with the HUC_8 and HUC_10 columns in the access database to the HUC raster.

  1. Load the HUC12 table in the Huc.mdb database into ArcMap

    a. From the ArcMap Toolbar, click on the *Add Data* button.

      b.   In the *Add Data* dialog, navigate to the Huc.mdb database that contains the Huc12 table. Open the mdb database, select the Huc12 table and click **Add**.

2.   Join the HUC12 table with the HUC_8 and HUC_10 codes to the HUC12 raster.

      a.   Right-click on the HUC12 (huc12r) raster in the TOC and select **Join and Relates > Join**.

      b.   From the *1. Join Data* dialog, set *Choose the field in the layer that the join will be based on* to **HUC_12.**

      c.   Set *2. Choose the table to join to this layer…"* to the Huc12 table which contains the HUC_12, HUC_10 and HUC_8 values.

      d.   Set *3. Choose the field in the table to base the join on* to **HUC_12.**

      e.   Click **OK**.

3.   Export the HUC12 raster to create a joined HUC12 raster which has the HUC_8 and HUC_10 attributes permanently included in the attribute table.

      a.   Right-click on the HUC12 raster (huc12r) in the ArcMap Table of Contents (TOC). Select **Data > Export Data**.

      b.   In the *Export Data* dialog, specify the path for the exported raster.

      c.   Set the *Name* to "hucs".

      d.   Set *Format* to **GRID.**

      e.   Click on **Save**.

      f.   ArcMap will ask if you want to load this newly exported raster. Answer **Yes**.

4.   The FRCCmt can use the Hucs raster for all 3 input landscape layers. However, if you want to have separate Huc_10 and Huc_8 rasters, they can be created from the Hucs raster using a Lookup Reclass.

      a.   Open **ArcToolbox > Spatial Analyst Tools >Reclass >Lookup** to open the *Lookup* dialog.

      b.   Set *Input raster* to your Hucs raster.

      c.   Set *Lookup field* to **HUC_10**.

      d.   Set *Output raster* so it contains the path you would like for your output HUC_10 raster.

      e.   Select **OK**.

      f.   Repeat this process with the HUC_8 attribute to create the HUC_8 raster.

5.   If you open the Hucs raster attribute table, you'll notice that it added another column with HUC_12 codes which is called *HUC_12_13,* a copy of the COUNT attribute called *COUNT_* and a copy of the Value attribute called *VALUE_*. It's OK to delete these attributes from the

attribute table by clicking on the attribute header to select the attribute, then right-clicking and selecting **Delete Field** from the context menu.

NOTE: Due to a bug in ArcMap 10, when you delete a field from a table in ArcMap, ArcMap does not show the correct column headers in the attribute table. If the raster is removed from the TOC and reloaded, the attribute table will show the correct column headers.

3. **Removing small HUC sliver polygons.** If the HUC rasters are clipped to a boundary polygon defining the analysis area, it is possible that small sliver HUCs could result where the boundary polygon does not match up with the HUC boundaries. One method for merging these sliver HUCs into neighboring HUCs is very similar to the process employed above to create the HUC_10 and HUC_8 rasters, as outlined in the following steps:

   a. You can identify whether your HUC_12 raster will have sliver HUCs is to look at the raster's attribute table when you are preparing to export it in step 2.f.ii above. If there are some HUCs that have a very small value in the COUNT attribute compared to other HUCS. If you do find sliver HUCs, add the following steps while preparing the HUC raster for use with the FRCCmt.

   b. In Step 2.f.iii.1.c, also add a column named "HUC_12_Merge" to the Huc12 table. Set the *Data Type* to **Text** and the *Field Size* to "12".

   c. In Step 2.f.iii.1.d, also populate the HUC_12_Merge column. Use the following update query in the SQL View in step 2.f.iii.d.v:

      UPDATE Huc12
      SET Huc12.HUC_10 = Left(Huc12.HUC_12, 10),
          Huc12.HUC_8 = Left(Huc12.HUC_12, 8),
          Huc12.HUC_12_Merge = Huc12.HUC_12

   d. After opening the Huc12 table in step 2.f.iii.1.d.viii, look for any rows with a small column in the COUNT_ column. These will likely be slivers that will need to be merged away. Identify the HUC12 code that you would want the sliver HUC to be merged into and set the HUC_12_Merge column to that HUC_12 code in that row.

   e. When the HUC_10 and HUC_8 rasters are created with the Lookup Reclass in Step 2.f.iv.4, repeat the Lookup Reclass with field Huc_12_Merge to create a Huc_12 raster without the sliver HUCs.

4. **Clip the BpS and SClass rasters to the Hucs raster.** When downloaded from the National Map via the Landfire Data Access Tool (LFDAT), the BpS and SClass rasters contain values for all pixels within the raster extent. It's desirable to clip the BpS and SClass rasters so they contain the same spatial footprint as the HUC raster.

Note: This write-up uses Raster Calculator to clip rasters instead of the Clip tool. In ArcGIS 10, the clip tool does not appear to correctly apply the Mask setting, while Raster Calculator does.

   a. Make sure that both the BpS and SClass rasters that were downloaded from the National Map are loaded into ArcMap.
   b. Launch Raster Calculator in batch mode by going to **ArcToolbox > Spatial Analyst Tools > Map Algebra .** Right click on **Raster Calculator** and select **Batch***.
   c. When the batch *Raster Calculator* dialog box comes up, double click in the *Map Algebra expression* cell in row 1.
   d. The *Raster Calculator:1* dialog box will come up. Under *Layers and variables*, double-click the BpS raster. The name of the raster (as it appears on the TOC) will appear in double quotes inside the Map Algebra Expression box. Click **OK** to accept the changes and close the *Raster Calculator:1* dialog box. In the batch *Raster Calculator* dialog box, the name of the first raster to be clipped will appear within double quotes in the *Map Algebra expression* cell in row 1.
   e. Specify the raster name and location for the clipped raster by clicking in the *Output raster* cell in row 1. Specify the full path name for the output clipped raster that Raster Calculator will create (for example, c:\sample\bpsc). Unfortunately, double clicking on the cell will not open an Output Raster dialog box that can be used to specify the location and name of the output raster.
   f. Use the *Add Row* button on the right to add an additional row to the batch Raster Calculator table where you can specify the SClass raster (and any additional rasters) to clip. The *Add Row* button looks like a plus symbol. The SClass and any additional rasters can be specified on additional lines by following steps D~~4~~ and E~~5~~ above on each subsequent row created in the batch Raster Calculator table.
   g. Set the Environment Settings by clicking on the **Environments** button.
   h. In the *Environment Settings* dialog box, do the following:
      i. Click on **Processing Extent**. Set the *Extent* to the **Hucs** raster (huc12r).
      ii. Click on **Fields**. Uncheck *Maintain fully qualified field names.*
      iii. Click on **Raster Analysis**. Set the *Cell Size* to the Hucs raster (huc12r).
      iv. Under *Raster Analysis, s*et *Mask* to the Hucs raster (huc12r).
      v. Click on the **OK** button to save the settings and close the *Environment Settings* dialog box.
   i. Click on the batch *Raster Calculator*'s **OK** button. The batch Raster Calculator will close and there will be a status field on the bottom of ArcMap that will indicate that Raster Calculator is running along with its percent complete.
   j. Once Raster Calculator is complete, the clipped rasters will appear in ArcMap.

5. **Join the attributes from the original BpS and SClass rasters to the clipped BpS and SClass rasters.** The FRCCmt relies on attributes other than the VALUE attribute in both the BpS and SClass. After clipping the rasters, it's necessary to join the attribute tables from the original rasters back to the clipped rasters. Other rasters that primarily use the VALUE attribute to contain the most meaningful information (like a DEM or Slope raster) do not need to have the original attribute tables joined to the clipped rasters.

   a. Export the attribute table from the original BpS and SClass rasters.
      i. Open the attribute table of the original BpS raster by right clicking on the raster in the *Table of Contents* and selecting **Open Attribute Table.**
      ii. In the *Table* dialog box, click on the *Table Options* button on the tool bar and select **Export.**
      iii. In the *Export Data* dialog box, click on the *Browse* button to select the location and name for the exported attribute table. In the *Saving Data* dialog:
         1. Navigate to the folder where you want to place the exported attribute table.
         2. Change the *Save as type* to **Text File.**
         3. Set Name to "BpS.csv".
         4. Hit **Save.**
      iv. On the *Export* Data dialog box, click on the **OK** button.
      v. A message box will come up asking *Do you want to add the new table to the current map?* Click on **Yes**.
      vi. Repeat this process exporting the SClass raster's attribute table to SClass.csv.
   b. Append the exported attribute table to the clipped raster's attribute table.
      i. In the *Table of Contents*, right click on the clipped BpS raster (bpsc). Select **Joins and Relates > Joins.**
      ii. On the *Join Data* dialog box, in the *1. Choose the field in this layer that the join will be based on:* combo box, select **VALUE**.
      iii. Under *2. Choose the table to join to this layer,* select the table that was exported from the original raster (BpS.csv).
      iv. Under *Choose the field in the table to base the join on*, choose **VALUE_**.
      v. Click on the **OK** button.
      vi. Export the clipped raster (bpsc) by right clicking on it in the TOC and select **Data > Export Data**.
      vii. In the *Export Raster Data* dialog box set the following parameters:
         1. Set the *Location* to the folder where the joined BpS raster will reside.
         2. Set the *Format* to **GRID.**
         3. Set *Name* to the name the joined BpS raster will have. (For example, bpsj).
         4. Click on the **Save** button.
         5. A message box comes up asking *Would you like to add the exported data to the map as a layer?* Select **Yes.**

viii. The joined BpS raster's attribute table contains some extra columns that may seem redundant like *ROWID_, VALUE_ and* COUNT_ . You can delete those attributes if desired.

NOTE: Due to a bug in ArcMap, when you delete a field from a table in ArcMap, ArcMap does not show the correct column headers in the attribute table. If the raster is removed from the TOC and reloaded, the attribute table will show the correct column headers.

ix. Repeat this process for the SClass raster.

6. **Convert the LANDFIRE Refresh BpS raster into a BpS Group raster.** (Only if using LANDFIRE Refresh rasters.) If LANDFIRE Refresh BpS and SClass rasters are being used, the correct attribute to have the FRCCmt use with the BpS raster is the GROUPMODEL attribute. The FRCCmt requires that the values in the attribute used with the BpS raster (GROUPMODEL) be unique. It is common when you look at the GROUPMODEL attribute in the BpS raster attribute table, a given value will show up in the single attribute will show up more than once. In order to rectify this problem, it is necessary to create a BpS Group raster from the Bps raster. This process will not need to be used if the

   a. Make sure the clipped BpS raster (bpsj) is loaded into ArcMap and its attribute table includes the GROUPMODEL attribute.
   b. Do a Lookup Reclass of the BpS raster on the GROUPMODEL attribute.
       i. Open **ArcToolbox > Spatial Analyst Tools >Reclass >Lookup** to open the *Lookup* dialog.
       ii. Set *Input raster* to the clipped BpS raster (bpsj).
       iii. Set *Lookup field* to **GROUPMODEL**.
       iv. Set *Output raster* so it contains the path you would like for your output BpSGroup ArcGRID. (For example, c:\sample\bpsgrp)
       v. Select **OK**.